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Revision 1

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Transportability Testing Procedures

VALIDATION ENGINEERING DIVISION
Directorate for Engineering
U.S. Army Defense Ammunition Center
McAlester, OK 74501-9053

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I. SCOPE.

The following test procedures delineate the requirements for testing/validating tactical military vehicles and ammunition outloading procedures by simulating operating conditions to determine the suitability of the procedure for use when shipping munitions by intermodal freight containers, commercial or tactical truck, trailer, or railcar.

II. DEFINITIONS.

A. Test Load (specimen). The inert munitions outloaded IAW prescribed procedures
in/on the appropriate transport mode.

B. Outloading Procedure. The procedure for loading, blocking and bracing, and restraining the load. Outloading procedures are prepared/ designed by the U.S. Army Defense Ammunition Center (DAC), Transportation Engineering Division.

III. REQUIREMENTS.

A. Tests.

1. Test Load (specimen). The test load shall be prepared using the same blocking and bracing methods specified in the outloading procedures proposed for use with the munitions. The intermodal container, truck, or railcar used in the test shall be inspected to assure its adequacy for munitions transport. Items used to build the load shall be inert (non-explosive). The weight and physical characteristics of the load configuration shall simulate the live (explosive) ammunition provided for in the outloading procedure; i.e., weights, physical dimensions, center of gravity, etc. The ammunition packages used shall duplicate that of the live ammunition. Certification of packaging/unitization will have already been accomplished by the appropriate agency; e.g., TACOM-ARDEC Packaging and Engineering Support Division, AMCOM, USN, USAF, U.S. Army Test and Evaluation Command (ATEC), or DAC.

2. Test Procedures. The test load (specimen) shall be subjected to a series of tests as described in the test methods detailed in Paragraph IV. The tests shall be conducted in the following sequence: (All tests may not be required for a specific item. A DAC cost estimate shall identify the tests to be conducted.)

a. Rail Test (Test Method 1).

b. On/Off Road Test:
   (1) Hazard Course (Test Method 2)..
   (2) Road Trip (Test Method 3).
   (3) Washboard Course (Test Method 4).

c. Ocean-Going Vessel Test:
(1) Shipboard Transportation Simulator (STS) (Test Method 5),
(2) 80-Degree Tilt Test (Test Method 6).

3. Data Collection. The test load (specimen) shall be instrumented as determined by the Test Engineer, or as requested by the test sponsor, to determine movement forces, velocities, and accelerations. The data collected should be suitable for use in investigating causes for failure and as criteria for design when developing new procedures. At the discretion of the Test Engineer, or as requested by test sponsor, blocking and bracing and other dunnage members subject to failure may be instrumented at critical points with strain gages, load cells, and displacement gages.

4. Failure Criteria. At the conclusion of each test, or at any time deemed necessary by the Test Engineer, the load shall be examined. Excessive shifting of contents, loosening or breaking of load restraints or blocking and bracing, deformation of tie-down fittings, or any visible damage to the items in the load or their packaging, or any other discernible damage which could render the item being shipped unsuitable/unsafe for its intended use, shall constitute failure. Normally, testing will be stopped when it becomes apparent that the load will fail; however, the test may be continued until complete failure if Test Engineer and/or test sponsor determine that usable data will be developed and safety of personnel and equipment integrity will not be violated.

B. Report. Following the test, a report shall be prepared which shall include the following:

1. A statement that the test was performed IAW this procedure, or if not, a description of deviations from the procedure.

2. A drawing of the load (specimen) outloading procedure including, as appropriate, unit load, item and packaging dimensions and weights. If other than inert ammunition items are used to build the load, the items should be listed and variation from actual munition noted.

3. The results of the test with the final condition of load described in detail. If test was stopped prior to completion IAW this procedure, damages to the load shall be described in detail.

4. Serial numbers and descriptions of the transportation equipment utilized in the test.

5. A statement that the outloading procedure, or tactical vehicle, has been tested and found satisfactory for use in shipping live munitions, or that the procedure was tested and found unsatisfactory. Causes for rejection shall be detailed and complete.

6. The report should include recommendations/information, acquired through observation, to improve the outloading procedure being tested.

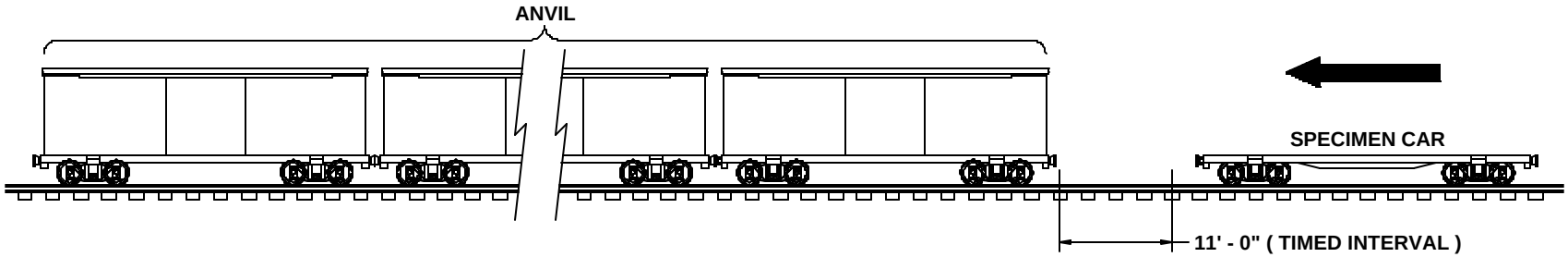
7. Photographic coverage (including still photos and/or video tapes) will be provided during the test and will be used as a part of the report documentation to verify procedure certification and/or illustrate failure/damage.

8. An interim report may be provided the customer within two weeks, if desired by the customer. The complete and final report shall be provided the customer within 60 days from the last testing date.

IV. TEST METHODS.

A. Rail Impact Test (Test Method 1). The test load or vehicle should be positioned in/on a railcar. For intermodal freight containers, the loaded container shall be positioned on a container chassis or on a COFC railcar and securely locked in place using the twist locks at each corner, as applicable. The container chassis shall be secured to a railcar. Equipment needed to perform the test includes the specimen (hammer) car, five empty railroad cars (or equivalent to 250,000 lbs.) connected together to serve as the anvil, and a railroad locomotive. These anvil cars are positioned on a level section of track with air and hand brakes set and with the draft gears compressed. The locomotive unit shall pull the specimen car several hundred yards away from the anvil cars, push the specimen car toward the anvil at a predetermined speed, and disconnect from the specimen car approximately 50 yards away from the anvil cars, which shall allow the specimen car to roll freely along the track until it strikes the anvil. This shall constitute an impact. Impacting shall be accomplished at speeds of 4, 6, and 8.1 mph in one direction and at a speed of 8.1 mph in the opposite direction. The tolerance for the speeds is plus .5 mph, minus 0 mph. Impact speeds shall be determined by using an electronic counter to measure the time required for the specimen car to traverse a specific distance (Figure 1) immediately prior to impact. Between impacts, the anvil railcars shall be inspected and the brakes reset if necessary.

ASSOCIATION OF AMERICAN RAILROADS (AAR)
STANDARD TEST PLAN



4 BUFFER CARS (ANVIL)
WITH DRAFT GEAR COMPRESSED
AND AIR BRAKES IN A SET POSITION

ANVIL CAR TOTAL WT. 250,000 LBS (APPROX)

SPECIMEN CAR IS RELEASED BY SWITCH ENGINE TO ATTAIN:

IMPACT NO. 1 @ 4 MPH
IMPACT NO. 2 @ 6 MPH
IMPACT NO. 3 @ 8.1 MPH

THEN THE CAR IS REVERSED AND RELEASED BY SWITCH ENGINE TO ATTAIN:

IMPACT NO. 4 @ 8.1 MPH

Figure 1. Rail Impact Sketch

B. On/Off Road Test:

1. Hazard Course (Test Method 2). The specimen load to be driven over a 200-foot-long segment of concrete-paved road that consists of two series of railroad ties projecting approximately 6 inches above the level of the road surface. This hazard course shall be traversed two times (Figure 2) for each test.

a. The first series of ties consists of 6 ties spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

b. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.

c. The second series of ties consists of 7 ties spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

d. The test load shall be driven across the hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

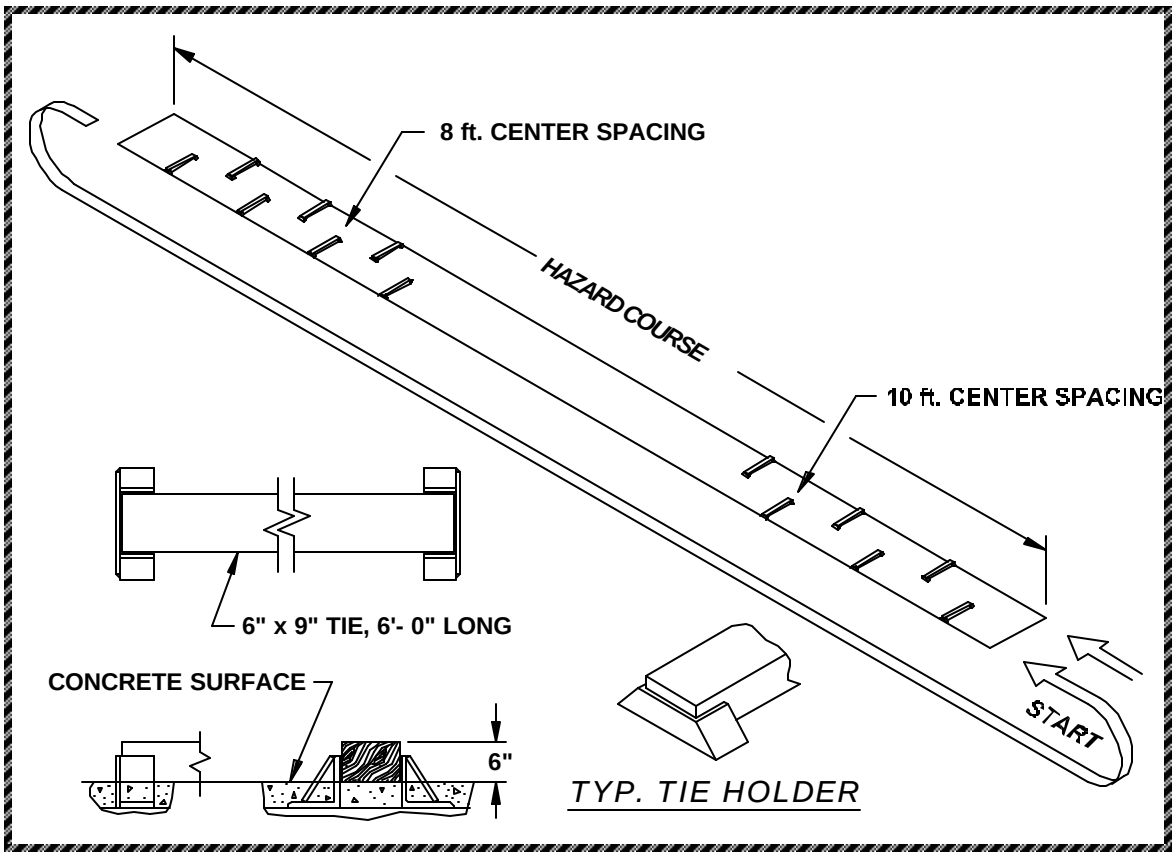


Figure 2. Hazard Course Diagram

2. Road Trip (Test Method 3). Using a suitable truck/tractor and trailer, or tactical vehicle, the tactical vehicle/specimen load of Test Methods 1 and 2 shall be driven/towed for a total distance of at least 30 miles over a combination of roads surfaced with gravel, concrete, or asphalt. The test route shall include curves, corners, railroad crossings, and stops and starts. The test vehicle shall travel at the maximum speed suitable for the particular road being traversed, except as limited by legal restrictions. This step shall provide for the tactical vehicle/specimen load to be subjected to three full airbrake stops while traveling in the forward direction and one in the reverse direction while traveling down an approximate 7-degree grade. The first three stops are performed at approximately 5, 10, and 15 mph, while the stop in the reverse direction at approximately 5 mph. If the specimen car is rail impact tested, panic stops shall not be required.

3. Washboard Course (Test Method 4). Using a suitable truck/tractor and trailer or tactical vehicle, the specimen load shall be towed/driven over the 300-foot-long washboard course at a speed which produces the most violent response of the particular test load (as indicated by the resonant frequency of the suspension system beneath the load) in the vertical direction. The washboard course shall be constructed as shown in Figure 3.

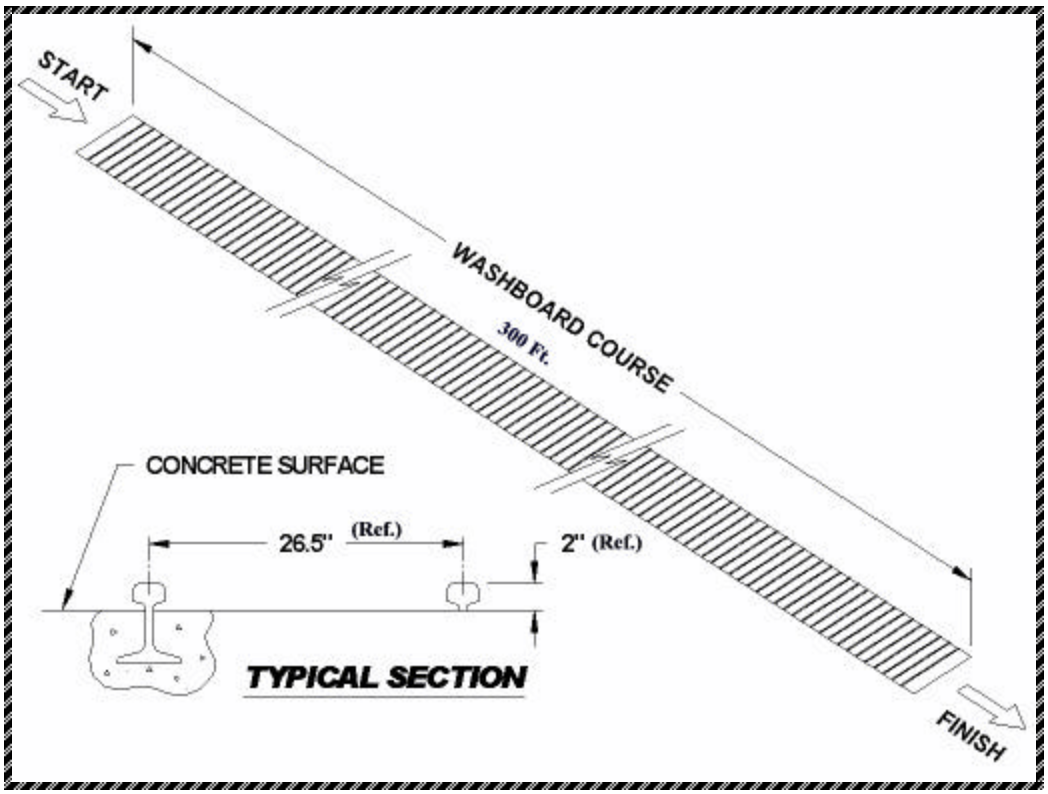


Figure 3. Washboard Course Diagram

C. Ocean-Going Vessel Test.

1. Shipboard Transportation Simulator (Test Method 5). The Shipboard Transportation Simulator (STS) is used for testing loads in 8-foot-wide by 20-foot-long intermodal freight containers. The specimen shall be positioned onto the STS and securely locked in place using the cam lock at each corner. Using the procedure detailed in the operating instructions, the STS shall begin oscillating at an angle of 30 degrees, plus or minus 2 degrees, either side of vertical center and a frequency of 2 cycles-per-minute (30 seconds, plus or minus 2 seconds) for a duration of two (2) hours. This frequency shall be observed for apparent defects that could cause a safety hazard. The frequency of oscillation shall then be increased to 4 cycles-per-minute (15 seconds, plus or minus 1 second per cycle) and the apparatus operated for two (2) hours. If an inspection of the load does not indicate an impending failure, the frequency of oscillation shall be further increased to 5 cycles-per-minute (12 seconds, plus or minus one second per cycle), and the apparatus operated for four (4) hours. The operation does not necessarily have to be continuous; however, no changes or adjustments to the load or load restraints shall be permitted at any time during the test. After once being set in place, the test load (specimen) shall not be removed from the apparatus until the test has been completed or is terminated.

2. 80-Degree Tilt Test (Test Method 6). This test method is used for testing loads in intermodal freight containers other than 20-feet-long. This test shall be employed as an alternate to Test Method 5 and is required when the intermodal container specimen is physically incompatible with the STS. The test load (specimen) shall be positioned on level terrain with the bottom corner fittings resting on timbers so the entire container is supported solely by the bottom corner fittings. The timbers shall be oriented parallel to the end rails of the container and extend 2 feet beyond the corner fittings on each side. Using two mobile cranes and appropriate rigging, the container shall be rotated (tilted) using the bottom corner fittings on one side as a fulcrum. The rigging (slings) of one crane shall be attached to the bottom corner fittings of the long side and the rigging (slings) of the second crane shall be attached to the top corner fittings on the opposite side. The tilting shall be accomplished by lifting the bottom corner fittings with the first crane so the container rotates about the opposite bottom corner fittings (fulcrum). Lifting/rotating by the first crane is continued until the center of gravity passes over the fulcrum, at which point the second crane shall provide support to the container and lower the container to the 80 degrees, plus or minus 2 degrees position. Rotation shall be accomplished smoothly at a slow speed so the container sidewall is subjected only to the static force of the interior load. The crane booms shall be adjusted to maintain a rear vertical suspension of the rigging at all times. In the case of end-opening type containers, at least one door (lower side of tilted container) must be closed and fastened throughout the test. The container shall be held in the tilted position for a minimum of two minutes. At which time, observations of both the container structure and the interior load shall be made. When the test is completed, the container shall be returned to its upright position using the same manner and care in handling.

ANNEX

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